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## Benchmarks for the assessment of wage developments


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# BENCHMARKS FOR THE ASSESSMENT OF WAGE DEVELOPMENTS

## 1. INTRODUCTION

Assessing the implications of wage developments for the build-up and correction of macroeconomic imbalances is a key building block of a proper analytical underpinning of the EU Macroeconomic Imbalances Procedure (MIP). In particular, such an assessment would be part of the analysis contained in the In-Depth-Reviews (IDRs) of country situations carried out by the Commission staff.

Such an assessment requires answering to some non-trivial questions. Are wage developments consistent with standard responses to fundamentals? Is the growth in labour costs compatible with orderly developments in price competitiveness? In order to answer these questions, and to assess whether labour cost developments contributed to the correction or to the amplification of macroeconomic imbalances, one has to compare actual labour cost and wage developments to appropriate benchmarks.

To this purpose, this paper presents alternative benchmarking frameworks. The interpretation of the benchmarks described below should not be mechanistic and need to take into account underlying simplifying assumptions and robustness issues. In addition, an overall assessment of wage developments needs to look at a broader set of variables and cannot be limited to these benchmarks.

The first approach is based on the comparison of actual wage growth to those predicted on the basis of a limited number of domestic macroeconomic fundamentals: changes in labour productivity, unemployment and inflation. This approach permits to assess if wage growth is broadly in line with equilibrium in the domestic labour market ("internal equilibrium"). The cross-country comparison of wage levels complements the assessment of wage growth, and permits to analyse the role of structural determinants that move wages over the longer term.

The second approach consists of comparing the actual wage growth with the wage growth that would have guaranteed a stable evolution in price competitiveness. In this case, the aim is that of identifying a benchmark suggestive of "external equilibrium", namely, wage growth consistent with orderly developments in the Real Effective Exchange Rate (REER). However, what is relevant for rebalancing is not only relative labour costs in the domestic economy as compared with foreign partners, but also relative labour costs between the tradable and the non-tradable sector. For this reason, the paper also analyses trends and determinants of wages in the tradable and non-tradable sector separately.

The remainder of the paper is organised as follows. The second section illustrates the approach of wage benchmarking based on domestic macroeconomic fundamentals. The third section looks at wages from the perspective of external equilibrium and proposes a wage benchmark based on price competitiveness. This section also studies wage trends in the tradable and non-tradable sectors separately. The fourth section concludes.

## 2. WAGES AND FUNDAMENTALS

In this section wages are compared to predictions based on macroeconomic fundamentals. Such a comparison answers implicitly the following question: are wages in line with domestic labour market equilibrium? Conditions for balanced labour supply and demand can be derived, for example, in the case of constant return to scale, perfect competition, in the absence of factor-biased technological progress and fully flexible wages and prices.

Assuming a Cobb-Douglas production function $Y = AK^{\alpha}L^{(1-\alpha)}$, where $Y$ is value added, $K$ and $L$ are, respectively capital and labour quantities, $A$ is a technological parameter representing factor-neutral technical progress while $\alpha$ is the weight of capital in the Cobb-Douglas production function. The marginal product of labour ($MPL$) can be expressed as:

$$MPL = A(1-\alpha)\left(\frac{K}{L}\right)^{\alpha} \qquad (1)$$

Cost minimization by firms under perfect competition leads to equality between the real wage and the marginal product of labour:

$$\frac{w}{p} = MPL \qquad (2)$$

where $w$ is the wage rate and $p$ is the producer price. The relation in (2) defines the demand for labour.

The percentage change in the real wage therefore equals the percentage change in the marginal product of labour, which, in absence of factor-biased technical progress, also equals the change in average labour productivity (*APL*):

$$\left(\frac{\hat{w}}{p}\right) = \hat{MPL} = \hat{A} + \alpha\left(\frac{\hat{K}}{L}\right)^{\alpha} = \hat{APL} \qquad (3)$$

where rates of change are labelled by "^".

From (2) and the fact that unit labour costs (*ULCs*) are expressed as *ULC=w/APL*, it follows that cost minimization under constant returns to scale and perfect competition implies that real unit labour costs (*RULCs*) and the wage share (*WS*) remain constant as *RULC=(w/p)/APL=wL/pY= WS*. Note that the share of labour in value added is given by *WS=MPL*L/Y=1-α*,, i.e., labour is paid in proportion to its contribution to value added *Y*. Hence, under the assumed conditions: (i) wages grow in line with labour demand and there is no unemployment; (ii) labour is rewarded on the basis of its contribution to value added; (ii) the wage share and real unit labour costs (*RULC*) remain constant.

In order to formulate a benchmark based on macro fundamentals the simple framework described above has to be extended to accommodate more realistic assumptions about the functioning of labour markets. Imperfect, lagged price adjustment, indexation, imperfect labour matching and wage inertia all imply that also unemployment will play an important role in the determination of wages. Therefore the general expression for nominal wages takes the following form:

$$\ln(\hat{w}) = f(\underset{+}{\hat{APL}}, \underset{+}{\hat{p}}, \underset{-}{u}) \qquad (4)$$

where $u$ is the unemployment rate, $f(.)$ denotes a general function, and the subscripts denote the sign of the partial derivative of its arguments: higher productivity growth and inflation are expected to lead to higher nominal wages, while unemployment, acting as a labour supply shifter, is expected to have a negative sign. The advantage of using nominal wages is that the benchmarks based on fundamentals will be directly comparable to that based on price competitiveness.

On the basis of expression (4), the rest of this section develops benchmarks both for wage growth and levels. The wage growth benchmark uses time-series information and provides a historical assessment of wage developments in each country. In contrast, the wage level benchmark focuses on the cross-section variation and compares each country's wage level to that expected based on the average relationship between wages and fundamentals in the EU27.

### 2.1. ASSESSING WAGE GROWTH

The benchmark for nominal compensation per employee growth is predicted using a dynamic wage regression. The wage regression permits to obtain a benchmark that takes into account the response of wages to main determinants such as inflation, labour productivity and unemployment.

The dynamic relationship between nominal wage growth and the explanatory variables is specified as an *error-correction model*. This assumes that there is an equilibrium relationship between the nominal wage level, the price level, the unemployment rate and labour productivity to which nominal wages will converge even if there are transitory shocks that divert wages from this equilibrium. Note that such a framework does not exclude the possibility of reverse causation (e.g., wages affecting prices) and multiple long-run relations among the variables. It does not address the endogeneity of the labour productivity variable either.

In analogy with existing work (e.g., Nickell, 1987; Manning, 1993; Bell, Nickell, Quintini, 2002; Nunziata, 2005) the estimated dynamic wage equation can be obtained as a reduced form specification incorporating both demand and supply-side labour market determinants. Nominal

wages are assumed to be related to the price level, labour productivity, and unemployment.

- *Price levels* matter for both labour demand and labour supply. Firms are willing to offer higher wages if the price of their own output is higher; wage setters demand higher wages if the cost of living is higher. In principle, both product and consumption prices could be included in the equation. In light of the high collinearity of the two variables, only the price level variable that performed best, the CPI index was kept.

- *Labour productivity* is aimed at capturing labour demand: the higher the productivity of labour at given price level, the higher the nominal wages firms are willing to pay.

- *The unemployment rate* captures mostly supply-side determinants, as wage demands by unions are expected to become more moderate in the presence of higher unemployment.

The wage equation is estimated on an unbalanced panel comprising yearly data on EU27 countries between 1980 and 2010. The long-run equilibrium relationship is specified as:

$$\ln(wage_{it}) = \alpha_i + \beta_1 \ln(CPI_{it}) + \\ + \beta_2 u_{it} + \beta_3 \ln(productivity_{it}) + e_{it} \qquad (5)$$

where *i* and *t* index the countries and time, *wage* denotes nominal compensation per employee, *CPI* is the consumer price index, *u* is the unemployment rate, *productivity* is measured by the GDP/employment ratio, $\alpha_i$ is a vector of country fixed effects, and *e* is the error term.

Given that some variables are non-stationary, equation (5) is interpreted as a co-integrating relationship.([1]) The dynamic (error-correction) wage equation is specified as:

$$\Delta \ln(wage_{it}) = \mu_i + \theta_1 \Delta \ln(CPI_{it}) + \\ + \theta_2 \Delta u_{it} + \theta_3 \Delta \ln(productivity_{it}) + \gamma \hat{e}_{it-1} + \varepsilon_{it} \qquad (6)$$

where $\hat{e}_{it-1}$ is the error correction term, i.e., the estimated residual from (5), so that $\gamma$ measures the speed of adjustment to a random shock.

Both the level regression (5) and the dynamic regression (6) are estimated using the fixed effect estimator that controls for country-specific omitted factors. This estimator pools the within-country time-series variation of the sample to estimate the parameters of (5) and (6). In addition, it also has the property that the differences between the benchmark and the actual wage will sum to zero for each country in the sample. Therefore this benchmark assumes that wages grew on average in a balanced way in the sample period. As usual, standard errors are clustered according to the panel identifier.

In order to check the robustness of the estimates results are also presented for different country samples: OECD countries, EU27 countries, euro-area countries. In addition to the basic specification in (5) and (6), alternative specifications including terms of trade (higher terms of trade are expected to be reflected in higher wages) and the share of population with tertiary education (higher share indicates higher high-skilled labour supply that is expected to push average wages down) are estimated.

The results are presented in Tables 1 and 2. The coefficients of the long-run relation in Table 1 present the expected sign, on average nominal wages grow one to one with the price level and are significantly responsive to gains in labour productivity. The coefficient on unemployment has the expected sign, but it is often not estimated precisely enough to reach statistical significance. Also terms of trade and education variables have the expected sign.

The results of these error correction equations show a significant coefficient for the error correction term, which is supportive of cointegration among the variables in the long-run equation. The specification chosen to estimate the benchmark is specification (2) in Table 2, which comprises all EU countries. While it would be preferable to base the benchmark on the specification that includes education, unfortunately the education variable is available only with some lag. Nonetheless the benchmark predictions for

([1]) The satisfactory fit of the equilibrium relationship and the highly significant error correction terms both indicate that one can assume co-integration among the variables in (5). For this reason, and in light of the limited power of available panel integration and cointegration tests, those tests were not performed.

these two specifications are virtually indistinguishable.

The dynamic specification in Table 2 can be used to calculate a benchmark for nominal wage growth. Graphs 1 and 2 display the actual growth of nominal compensations per employee and the wage regression benchmarks.

The results indicate that, up to the financial crisis, in most countries wage growth did not diverge substantially from what is predicted on the basis of fundamentals. Until 2008, wage growth was often lower than that predicted by the fundamentals in Austria, Spain, Italy, Finland, Slovakia and, after 2003, in Germany, while in Sweden, the UK and until the early 2000s in Greece wage growth was consistently higher than that predicted by the fundamentals. Wage growth was considerably above benchmark in Latvia, Lithuania, and Hungary before the recession and also Romania exhibits wage growth above benchmark during the mid 2000s.

With the crisis, predicted real nominal wage growth fell considerably in 2009 in light of the sudden drop in falling and rising unemployment, so that actual wage growth considerably outpaced the benchmark in that year. As productivity rebounded in 2010, benchmark wage growth recovered, outpacing actual wage growth in most countries.

It is important to stress the limitations of the analysis and to take the results with a grain of salt. There is especially a relevant limitation in working with aggregate compensation-per-employee figures. When employment creation is predominantly in low-wage sectors aggregate nominal compensation per employee growth can be persistently lower than the benchmark prediction, since the latter is based on average relationships. This phenomenon could for instance partly explain the below-benchmark wage growth in Spain between 1997 and 2007.

### 2.2. ASSESSING WAGE LEVEL DIFFERENCES ACROSS COUNTRIES

Although information on wage growth is relevant, it needs to be complemented with information on wage levels, as wage growth above or below benchmark may be linked with an adjustment process to pre-existing imbalances. Hence, comparing wage levels across countries complements the discussion of wage growth: it puts the wage growth trends in perspective and reveals convergence/divergence trends.

Graph 3 shows separately for EU15 and EU12 countries the distribution of compensation per employee in purchasing power standard in 2000, 2005 and 2010. The most apparent characteristic of these distributions is their stability: their shift over time leaves relatively unchanged relative frequencies. Shifts in the wage distribution are roughly the same for both country groups, although the distribution for the EU15 had a more pronounced leftward shift between 2000 and 2010.

The relative stability of these distributions masks, however, some significant changes in the ranking of some member states in terms of compensation per employee. Table 4 presents the rankings for all three years and indicates in bold both member states that moved down/up more than one place during the decade in bold. The relative ranking of Poland, Germany and Sweden decreased quite substantially during the decade, while Ireland and the Netherlands moved up strongly. One can also observe a modest but steady increase in the ranking of Estonia, Romania, Slovakia and Slovenia.

These findings support the evidence of wage moderation in Germany and the strong wage growth for Romania and Estonia from the dynamic wage regression benchmark. In the case of Sweden and the UK, the analysis of the wage levels qualifies the findings of the wage regression benchmark: although wages grew more than what can be explained by fundamentals for quite a few years during the 2000s, the relative wage level within the EU did not deteriorate or even improved for Sweden.

Regressing wage levels across countries helps assessing the long-term impacts of structural variables. A cross-section regression is estimated on a balanced sample of EU27 countries between 2000 and 2010. The specification is similar to the dynamic wage regression specification in the previous section:

$$\ln(wage_{it}) = \alpha + \beta_1' u_{it} + \beta_2' \ln(productivity_{it}) + \\ + \beta_3' \ln(tertiary\_attainment_{it}) + d_t + u_{it} \quad (7)$$

where all notations are as before except that α is a general constant, $d_t$ are time fixed effects and the variable "*tertiary-attainment*" denotes the fraction of the population with tertiary education level. The major difference compared to equation (5) is that it includes time fixed effects instead of country fixed effects. This implies that the estimation is based on the pooled cross section variation of the variables, because differences in their year-specific means are captured by the time fixed effects. Variables are expressed in this case in purchasing power standards, in order to measure all monetary variables in the same unit. Since this transformation also adjusts for price level differentials, the price level is not included among the regressors. Tertiary education attainment is included in the specification in order to capture the long term shifts in the supply of skilled labour.

The expected sign of tertiary attainment is positive in a *cross-section* regression: the higher the tertiary education attainment in a country, the higher the average skills of the labour and the higher the average wage level. This is not in contradiction to the previous section, where the expected sign is negative, because in that case the regression captures variation in the skilled labour supply over time, not across countries (an increase in the skilled labour supply leads to a reduction in the return to skill and then in average wages over the short-to-medium-term).

Next to the base specification (7), separate regressions are estimated for different levels of educational attainment. In these regressions, the dependent variable is the mean equivalised net income instead of the compensation per employee. Given that this variable is only available for EU countries and that the aim is to compare EU member states in this section the robustness check with the alternative samples is not presented.

The results for all specifications are shown in Table 3. Coefficient estimates on labour productivity and unemployment are very close to the baseline regression estimates in column 2 of Table 1. The results also confirm the expected positive sign of tertiary education attainment in cross section: one percentage point increase in tertiary attainment is associated with around half a percentage point higher wages. The regressions by educational attainment show that the effect of tertiary attainment is not significant on the incomes of the population with tertiary education, while it is significantly positive for the population with lower education attainment. This result supports the view that workers with different skills are complementary in production.

Graph 4 shows the difference between the benchmark predicted from the simple wage level regression reported in the first column of Table 3 and nominal compensation per employee in percentage points for 2009, 2010 and 2011. Graph 5 repeats the same exercise with a specification including also the education variable (second column of Table 3). Since this variable is not available for 2011 results are only shown for 2009 and 2010.

Level misalignment results reveal that, while the order of the countries follows broadly the ranking of their wage levels presented in Table 4 and reflects to some extent the misalignment in wage growth discussed in the previous section, there are also some notable differences. ([1]) Once wage levels are compared with benchmarks, some countries having followed recent paths of high wage growth (e.g., Ireland, Latvia) or moderation (e.g., Germany) appear to exhibit broadly balanced positions after 2009. Conversely, some countries (Slovenia, Romania, Spain, Portugal) exhibit a misalignment in levels which does not show up in growth rates. In reading these results, it is important to bear in mind the meaning and limitations of cross-section predictions, notably specification issues, among which omission of relevant variables.

## 3. WAGES AND PRICE COMPETITIVENESS

In this section wage benchmarking follows the requirement of external balance rather than consistency with equilibrium in the domestic labour market. Moreover, this section also

([1]) This characteristic of the residuals suggests that there regression is unable to capture significant part of the variation in wage levels.

discusses the different trends in tradable versus non-tradable wage growth, because this is a key issue for competitiveness adjustments.

### 3.1. ASSESSING THE IMPLICATION OF WAGE GROWTH FOR PRICE COMPETITIVENESS

The most straightforward benchmark for wage growth is one consistent with a constant value of the REER computed on the basis of unit labour costs (ULCs). Such a benchmarks corresponds to an hypothetical, counter-factual growth rate for the nominal compensation per employee, assuming that developments in labour productivity and in the ULCs of competitors are unchanged compared with those actually observed.

This benchmark has no clear normative implications. It just permits to assess whether, keeping labour productivity and unit labour costs developments in partner countries unchanged, developments in nominal wage and non-wage labour costs are in line with the maintenance of price competitiveness, and therefore in this respect not harmful for external imbalances. The meaning of this benchmark is that of a consistency check and its usefulness is that it can separate the role of productivity and unit labour costs in foreign countries from those of labour cost per employee developments. It needs to be stressed that constant price competitiveness is a neutral benchmark, which is chosen for convenience. Desirable price competitiveness developments need not imply constancy of the REER. For example, if a country has a stronger relative productivity growth in the tradable sector compared to partner countries, in line with Balassa-Samuelson effects the REER would appreciate due to rising wages throughout the economy, but without significant implications for the export performance, since in the tradable sector productivity and wage dynamics would offset each other (necessarily so, because cross-border differences in the prices of tradables are limited by international competition and arbitrage). Similarly, countries in the process of correcting current account imbalances will also deviate from a constant REER.

How does the wage benchmark relate to the benchmark based on fundamentals? Since the latter is built around the wage-productivity relationship the two benchmarks can yield quite different results. Real wages growing in line with productivity are not sufficient for stable developments in REERs. By expressing the REER as follows (stars denote foreign variables):

$$REER=ULC/ULC^*=pRULC/p^*RULC^* \qquad (8)$$

it is clear that the constancy of real unit labour costs in all countries does not ensure a stable REER in light of the possible presence of inflation differentials.

Graphs 6 and 7 demonstrate that the differences between actual nominal compensation per employee growth and the constant-REER benchmark are often remarkable. This is for several reasons, including the fact that in some cases changes in REER are linked to nominal exchange rate developments (remarkable at the start of the financial crisis in a number of countries, e.g., UK, Romania, Poland) and that the requirement of a constant REER is a demanding one. Before monetary unification, among EU15 countries (EU Member States before 2004) the remarkable period of wage moderation in Germany stands out, similarly to the low wage growth in a number of countries, including France, Belgium and Finland. Conversely, over the same period, wage growth was above benchmark in the UK, Sweden, Italy. After monetary unification, wage growth was substantially above the constant-REER benchmark in Denmark, Spain, Greece, Ireland and Italy. In the EU12 Member States, wage growth generally exceeded the constant-REER benchmark between 1995 and 2010, except for Cyprus, Poland and Slovenia. Major competitiveness losses were recorded after mid 2000s in the Baltics, Romania, Bulgaria and Slovakia.

### 3.2. ASSESSING WAGE DYNAMICS IN THE TRADABLE AND NON-TRADABLE SECTORS

For a successful rebalancing process, resources need to be shifted from tradable to non-tradable goods and services. If wages remain high in the non-tradable sector this process cannot take place. In this respect, falling relative wages in the non-tradable versus the tradable sector favour the correction of current account deficits.

In order to assess whether wage developments in the tradable and non-tradable sectors are supportive of such re-allocation, separate wage regression benchmarks are estimated for tradable and non-tradable nominal compensation per employee growth. The specification is the same as in (5) and (6), with the exception of the price level variable: instead of CPI, the sector-specific GVA deflator is used. One would expect this specification to describe wage developments in the non-tradable sector better, because tradable-sector wages are to a larger extent affected by non-purely domestic determinants.

The estimation results for the long-run regression are presented Table 5, while the estimates of the dynamic regression are shown in Table 6. The parameter estimates are in the same range as the baseline regression both for the tradable and the non-tradable specifications.

The predicted benchmarks and the nominal compensation per employee growth for both sectors are presented in Graphs 8 to 11. In line with expectations, the differences between compensation per employee and the benchmark are larger on average in the tradable compared to the non-tradable sector. Several countries demonstrate subdued wage growth in the tradable sector before the recession: Austria, Belgium, Spain, Finland and Italy. There are also countries that show wage growth above benchmark in the same period: the Netherlands, Sweden, the UK, Cyprus, Latvia and Lithuania. Ireland and France show excessive wage growth since 2004. There are several countries that did not adjust wage growth to fundamentals in the tradable sector during the recession including Bulgaria, France, Italy and the Netherlands. In the non-tradable sector compensation per employee growth followed the benchmark in most cases, and several countries even showed subdued growth compared to the benchmark, including Germany, Spain, Finland, Ireland and the UK. However, Denmark and the Netherlands show wage growth higher than the benchmark for relatively long periods.

This evidence suggests that it is important to distinguish between wage developments in the tradable and non-tradable sectors. The aggregate wage growth benchmark based on fundamentals captures domestic macroeconomic developments that are comparatively more relevant crucial for the non-tradable sector. Therefore, any indication of large and sustained deviations from this benchmark is a signal of insufficient wage adjustment especially in the non-tradable sector.

## 4. CONCLUSION

Wage benchmarks appear as a useful prima-facie for the assessment of aggregate wage developments. Different benchmarks are needed to assess alternatively whether wages are consistent with developments in domestic macroeconomic fundamentals (“internal equilibrium”) or orderly developments in cost competitiveness (“external equilibrium”).

Such alternative wage benchmarks provide complementary information for the ex-post assessment of wage developments. In some cases, both benchmarks may reveal a relevant role of wages. For instance, in the case of Germany, all benchmarks confirm that in the second part of the 2000s moderate wage growth contributed to the reduction of the REER; symmetrically, in the case of Latvia, Lithuania, Hungary and the UK all benchmarks imply too high wage growth that could indicate the deterioration of competitiveness in the second half of the 2000s.

In other cases, indications from different benchmarks may send conflicting messages. For example, in the mid-2000s, wage growth does not appear to be consistent with stable competitiveness for Ireland and Slovakia. However, wage growth in both countries appears to be in line with fundamentals, as revealed by the benchmark based on the estimation of wage equations.

Although information on wage growth is relevant, it needs to be complemented with information on wage levels, as wage growth above or below benchmark may be linked with an adjustment process to pre-existing imbalances. Once wage levels are compared with benchmarks, some countries having followed recent paths of wage inflation (e.g., Ireland, Latvia) or moderation (e.g., Germany) appear to exhibit broadly balanced positions after 2009.

When repeating the benchmarking exercise for the tradable and non-tradable sectors the results reveal that wage developments in the non-tradable sector follow much closer the macroeconomic fundamentals than in the tradable sector, as wage dynamics in the tradable sector are partly linked to non-purely domestic factors. This underscores the relevance of analysing separately wage dynamics in the tradable and the non-tradable sector to assess the adjustment of relative wages during external rebalancing.

Needless to say, wage benchmarks have a limited role in identifying wage-related competitiveness challenges from a forward-looking perspective. For instance, the presence of indexation mechanisms in a given country could imply competitiveness losses when a trend towards rising prices of imported energy is foreseen. For this type of assessment, backward-looking wage benchmarks are of limited usefulness. Clear limitations are also linked to the use of nominal compensations per employee as an aggregate measure of wages, as changes in the composition of employment across labour types cannot be controlled for.

For the above reasons, as well because of the underlying simplifying assumptions and robustness issues, results from the benchmarks discussed in this paper need to be interpreted with the necessary caution and not at face value. A proper assessment of wage developments should also ideally look at developments in wages at a disaggregate level, and at different notions of actual wages and wage floors, including minimum wages, negotiated wages, wage drift.

# ANNEX

Table 1: Long-run wage equations, various samples, 1980-2011

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent variable: log nominal compensation per employee | OECD countries | EU countries | EU countries | EU countries | Euro-area EU countries |
| Explanatory variables | | | | | |
| Log CPI | 0.942*** | 1.017*** | 0.960*** | 1.189*** | 1.006*** |
| | (0.0303) | (0.0367) | (0.0208) | (0.0468) | (0.0324) |
| Unemployment rate | -0.00246 | - | -0.00192 | -0.00239 | -0.00170 |
| | (0.00149) | (0.00149) | (0.00129) | (0.00189) | (0.00110) |
| Log labour productivity | 0.887*** | 0.816*** | 0.867*** | 0.755*** | 0.782*** |
| | (0.0636) | (0.0750) | (0.0540) | (0.113) | (0.0862) |
| Log terms of trade | | | 0.416** | | |
| | | | (0.152) | | |
| Tertiary attainment | | | | -0.00457*** | |
| | | | | (0.00127) | |
| Constant | -2.457*** | - | - | -3.382*** | -2.661*** |
| | (0.137) | (0.116) | (0.701) | (0.168) | (0.106) |
| | | | | | |
| Observations | 935 | 657 | 657 | 451 | 452 |
| R-squared | 0.988 | 0.987 | 0.989 | 0.969 | 0.991 |
| Number of countries | 37 | 27 | 27 | 27 | 17 |

Estimation method: Fixed effects. Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1.
Data sources. Nominal compensation per employee, total economy: European Commission DG ECFIN AMECO database. CPI, 2000=100: AMECO., source: AMECO; Unemployment rate, source: Eurostat. Productivity: GDP / total employment. GDP source is AMECO; total employment source is OECD, complemented by Eurostat if missing. Terms of trade index, 2000=100: AMECO. Tertiary attainment: Eurostat.

Table 2: Wage equations, Error Correction Model, various samples, 1980-2011

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent variable: Δ log nominal compensation per employee | OECD countries | EU countries | EU countries | EU countries | Euro-area EU countries |
| Explanatory variables | | | | | |
| Δ Log CPI | 0.955*** | 0.985*** | 0.986*** | 1.078*** | 0.909*** |
| | (0.0574) | (0.0451) | (0.0414) | (0.0572) | (0.0557) |
| Δ Unemployment rate | - | -0.00441* | -0.00367 | -0.00436 | -0.000886 |
| | (0.00209 | (0.00238) | (0.00231 | (0.00298 | (0.00137) |
| Δ Log labour productivity | 0.295** | 0.234* | 0.251** | 0.186* | 0.113 |
| | (0.112) | (0.115) | (0.120) | (0.105) | (0.0788) |
| Δ Log terms of trade | | | 0.231*** | | |
| | | | (0.0685) | | |
| Δ Log fraction of tertiary | | | | - | |
| | | | | (0.00055 | |
| Error correction term | - | -0.162*** | - | - | -0.180*** |
| | (0.0227) | (0.0288) | (0.0301) | (0.0431) | (0.0334) |
| | | | | | |
| Constant | 0.0112** | 0.0128*** | 0.0117** | 0.0108** | 0.0151*** |
| | (0.00439 | (0.00359) | (0.00360 | (0.00349 | (0.00297) |
| | | | | | |
| Observations | 898 | 630 | 630 | 420 | 435 |
| R-squared | 0.780 | 0.747 | 0.762 | 0.619 | 0.762 |
| Number of countries | 37 | 27 | 27 | 27 | 17 |

Estimations method: Fixed effects. Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1.
Source: see footnote to Table 1.

Table 3: Cross section wage regressions

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent variable log nominal compensation per employee Explanatory variables | Log nominal compensation per employee, PPS | Log nominal compensation per employee, PPS | Mean equivalised net income; Tertiary education, PPS | Mean equivalised net income; Secondary education, PPS | Mean equivalised net income; Primary education, PPS |
| Log labour productivity | 0.953*** | 0.931*** | 1.005*** | 1.126*** | 1.228*** |
| | (0.00841) | (0.00921) | (0.0402) | (0.0403) | (0.0462) |
| Unemployment rate | -0.0104*** | -0.0108*** | -0.0185** | -0.0225*** | -0.0221*** |
| | (0.000984) | (0.000971) | (0.00474) | (0.00434) | (0.00258) |
| Share of tertiary educated | | 0.00455*** | 0.00187 | 0.00519* | 0.0125*** |
| | | (0.000418) | (0.00262) | (0.00245) | (0.00216) |
| | | | | | |
| Constant | -0.376*** | -0.375*** | 6.009*** | 5.152*** | 4.380*** |
| | (0.0357) | (0.0401) | (0.0893) | (0.0967) | (0.143) |
| | | | | | |
| Observations | 324 | 297 | 159 | 159 | 159 |
| R-squared | 0.881 | 0.888 | 0.797 | 0.816 | 0.825 |
| Number of countries | 27 | 27 | 27 | 27 | 27 |
| Number of years | 12 | 11 | 6 | 6 | 6 |

Estimations method: year fixed effects. Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1.
Source: see footnote to Table 1. Mean equivalised net income, pps: Eurostat; PPP: Eurostat.

Table 4: Member states ranking in terms of nominal compensation per employee in 2000, 2005 and 2010 (in PPS terms)

| Countries moving down in ranking | | | Countries moving up in ranking | | |
|---|---|---|---|---|---|
| 2000 | 2005 | 2010 | 2000 | 2005 | 2010 |
| BG | BG | BG | BG | BG | BG |
| RO | RO | LV | **RO** | **RO** | LV |
| LV | LV | LT | LV | LV | LT |
| LT | LT | RO | LT | LT | **RO** |
| EE | EE | **PL** | **EE** | **EE** | PL |
| SK | SK | HU | **SK** | **SK** | HU |
| HU | **PL** | EE | HU | PL | **EE** |
| **PL** | HU | SK | PL | HU | **SK** |
| CZ | CZ | CZ | CZ | CZ | CZ |
| PT | PT | PT | PT | PT | PT |
| CY | **MT** | **MT** | CY | MT | MT |
| SI | CY | CY | **SI** | CY | CY |
| **MT** | SI | EL | MT | **SI** | EL |
| EL | EL | SI | EL | EL | **SI** |
| FI | ES | **DE** | FI | ES | DE |
| IE | DK | FI | **IE** | DK | FI |
| DK | FI | **SE** | DK | FI | SE |
| ES | **DE** | DK | ES | DE | DK |
| **DE** | **IT** | ES | DE | IT | ES |
| **SE** | **SE** | **IT** | SE | SE | IT |
| UK | IE | UK | UK | **IE** | UK |
| **IT** | UK | FR | IT | UK | FR |
| FR | FR | IE | FR | FR | **IE** |
| NL | AT | AT | **NL** | AT | AT |
| AT | BE | BE | AT | BE | BE |
| BE | NL | LU | BE | **NL** | LU |
| LU | LU | NL | LU | LU | **NL** |

Source: see footnote to Table 1. PPP: Eurostat.

Table 5: Tradable and non-tradable long-run wage equations, various samples, 1980-2011

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Tradable | Non-tradable | Tradable | Non-tradable | Tradable | Non-tradable |
| Dependent variable: log nominal compensation per employee | OECD countries | | EU countries | | Euro-area countries | |
| Explanatory variables | | | | | | |
| Log GVA deflator | 0.952*** | 0.995*** | 0.960*** | 0.994*** | 0.927*** | 0.974*** |
| | (0.0203) | (0.0114) | (0.0116) | (0.0125) | (0.0234) | (0.0174) |
| Unemployment rate | 0.000395 | -0.00278* | -0.000107 | -0.00275* | - | -0.00114 |
| | (0.00135) | (0.00150) | (0.00129) | (0.00161) | (0.00206) | (0.00199) |
| Log labour productivity | 0.835*** | 0.963*** | 0.860*** | 0.983*** | 0.896*** | 0.900*** |
| | (0.0313) | (0.0723) | (0.0319) | (0.0769) | (0.0332) | (0.138) |
| | | | | | | |
| Constant | - | -2.623*** | -2.312*** | -2.669*** | - | - |
| | (0.0870) | (0.150) | (0.0492) | (0.138) | (0.0792) | (0.216) |
| | | | | | | |
| Observations | 677 | 677 | 554 | 554 | 373 | 373 |
| R-squared | 0.978 | 0.992 | 0.982 | 0.991 | 0.983 | 0.989 |
| Number of countries | 31 | 31 | 26 | 26 | 16 | 16 |

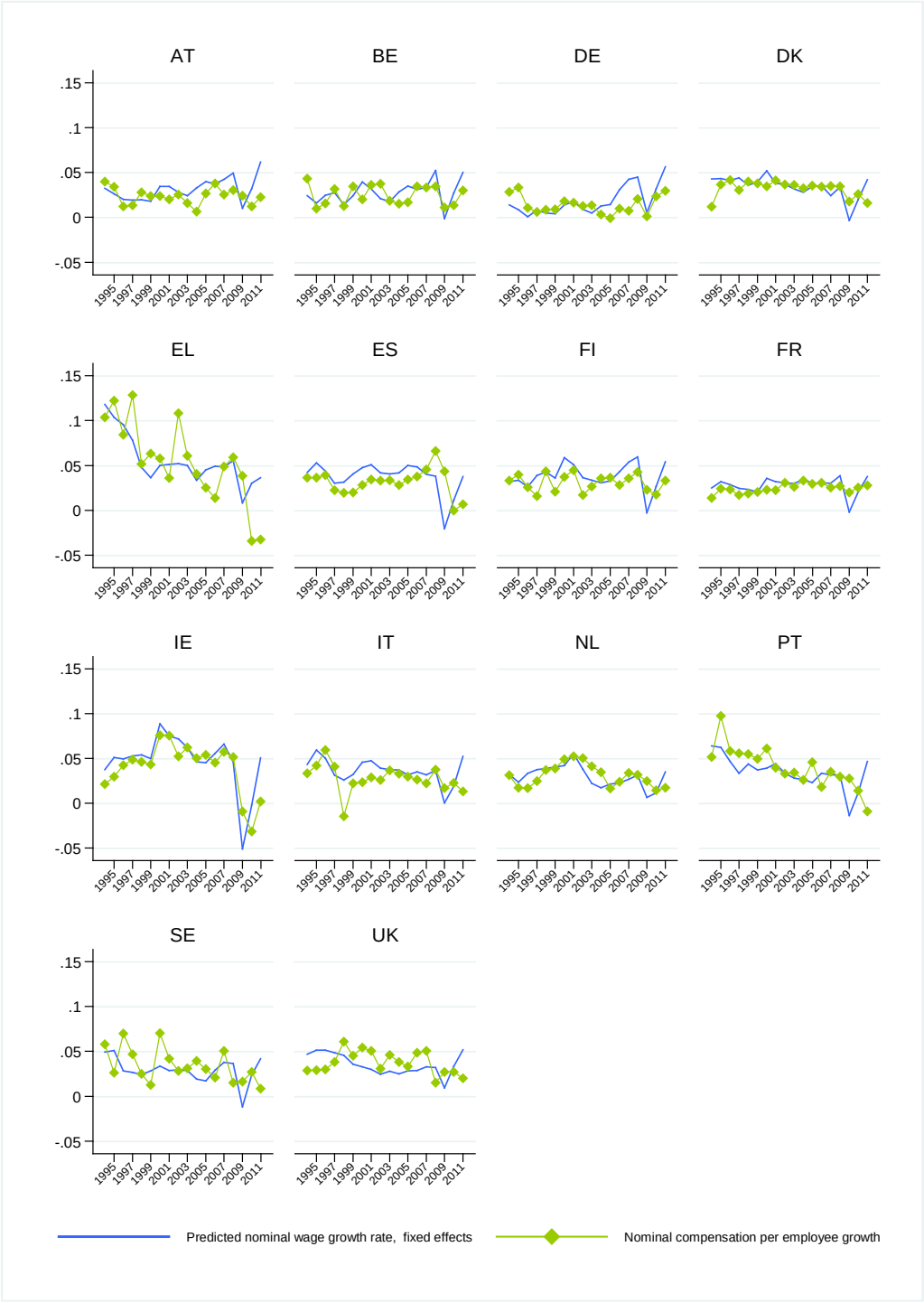
Estimations method: Fixed effects. Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1.
Source: see footnote to Table 1. GVA deflator: European Commission DG ECFIN AMECO database.

Table 6: Tradable and non-tradable wage equations, Error Correction Model, various samples, 1980-2011

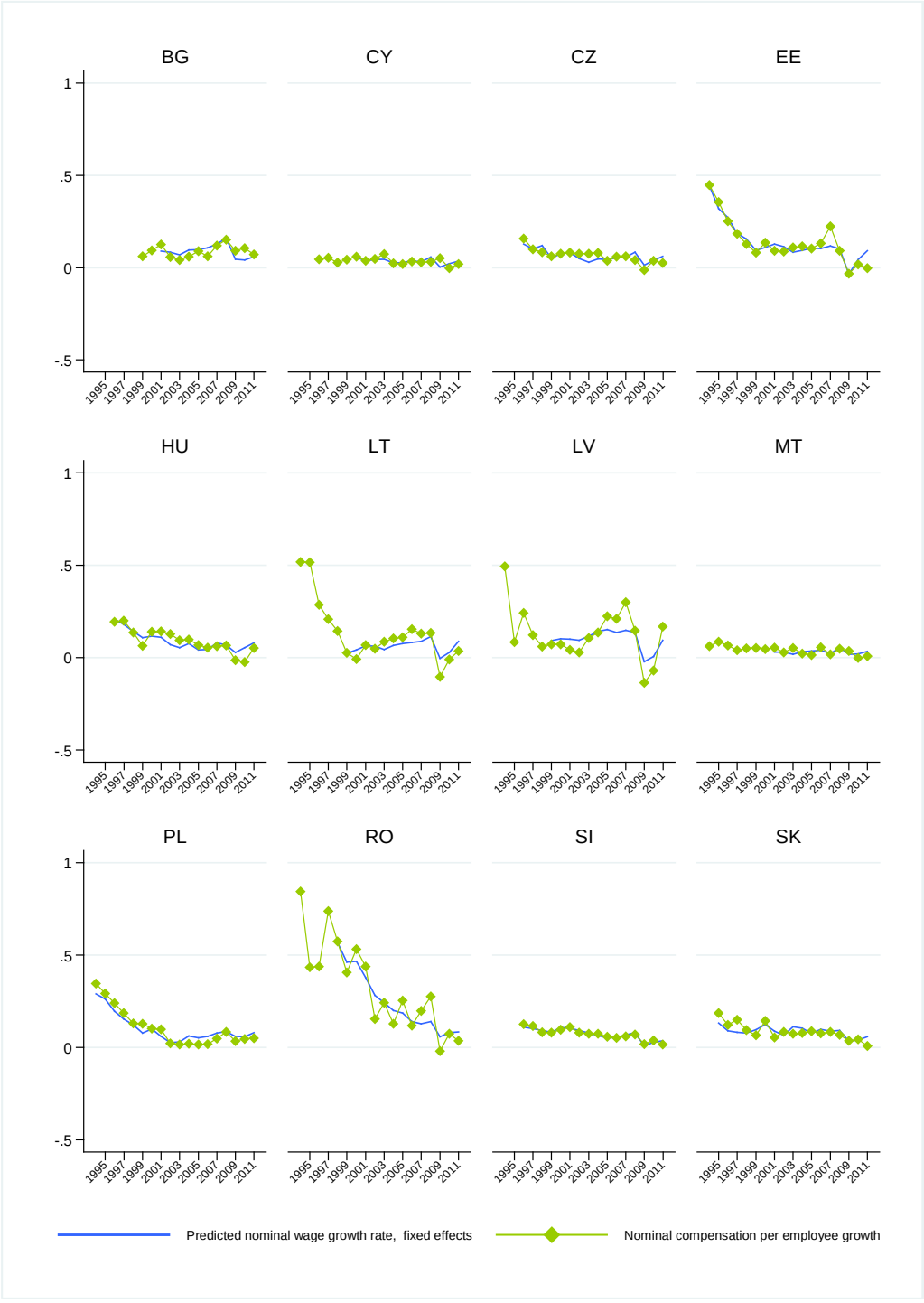
| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent variable Δ log nominal compensation per employee | Tradable | Non-tradable | Tradable | Non-tradable | Tradable | Non-tradable |
| Explanatory variables | OECD countries | | EU countries | | Euro-area countries | |
| Δ Log GVA deflator | 0.836*** | 1.028*** | 0.864*** | 1.029*** | 0.767*** | 0.837*** |
| | (0.0282) | (0.0123) | (0.0144) | (0.0117) | (0.105) | (0.0831) |
| Δ Unemployment rate | 0.000130 | -9.24e-05 | -7.65e-05 | 2.47e-05 | 0.000464 | 0.00137* |
| | (0.00174) | (0.00104) | (0.00190) | (0.00110) | (0.00103) | (0.000744) |
| ΔLog labour productivity | 0.494*** | 0.556*** | 0.508*** | 0.557*** | 0.340*** | 0.487*** |
| | (0.0875) | (0.0720) | (0.0881) | (0.0740) | (0.0804) | (0.0800) |
| Error correction term | -0.216*** | -0.211*** | -0.232*** | -0.218*** | -0.167*** | -0.173*** |
| | (0.0589) | (0.0343) | (0.0787) | (0.0364) | (0.0527) | (0.0447) |
| | | | | | | |
| Constant | 0.0147*** | 0.00180** | 0.0151*** | 0.00189** | 0.0190*** | 0.00819** |
| | (0.00332) | (0.000701) | (0.00272) | (0.000776) | (0.00418) | (0.00351) |
| | | | | | | |
| Observations | 646 | 646 | 528 | 528 | 357 | 357 |
| R-squared | 0.869 | 0.957 | 0.896 | 0.959 | 0.569 | 0.728 |
| Number of countries | 31 | 31 | 26 | 26 | 16 | 16 |

Estimations method: Fixed effects. Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1.
Source: see footnote to Table 1. GVA deflator: European Commission DG ECFIN AMECO database.

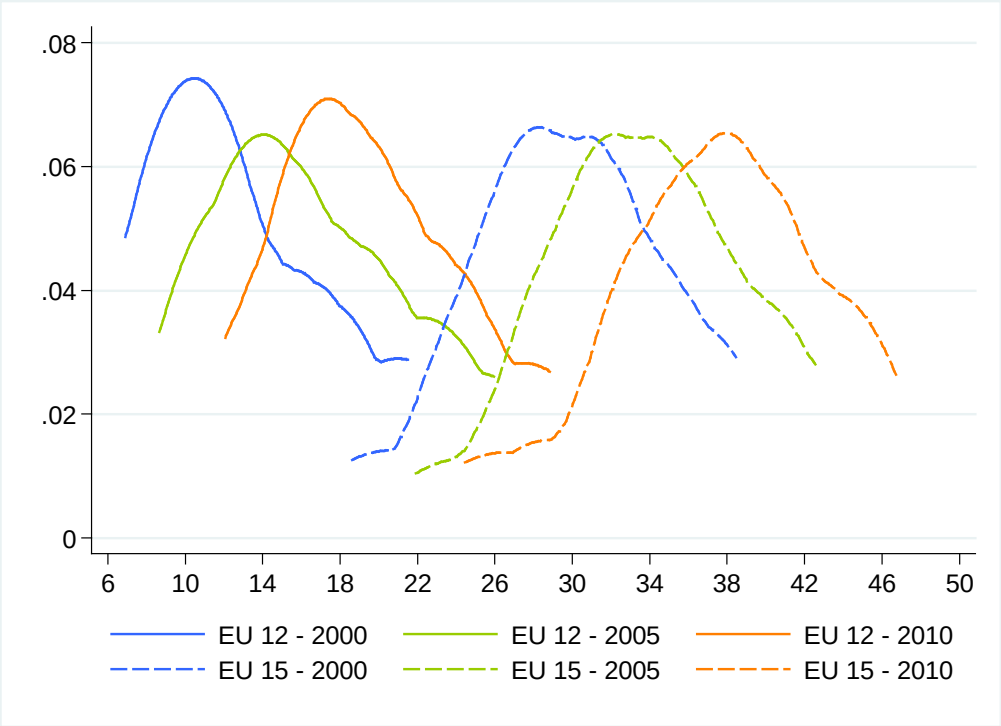
Graph 1: Benchmark for nominal compensation per employee growth: prediction from wage equation, EU15 (EU member states before 2004)



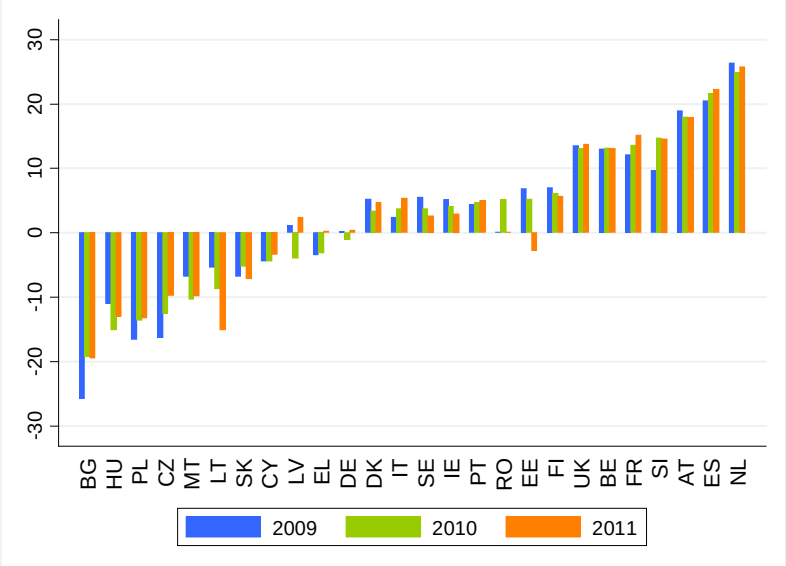
Graph 2: Benchmark for nominal compensation per employee growth: prediction from wage equation, EU12 (EU member states since 2004)



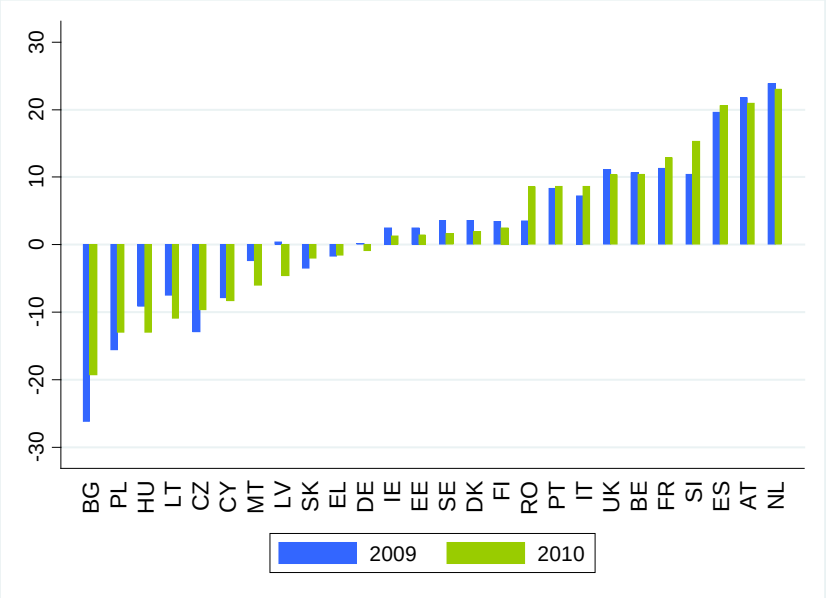
Graph 3: Distribution of nominal compensation per employee for EU12 and EU15 countries in 2000, 2005 and 2010 (in PPS terms)



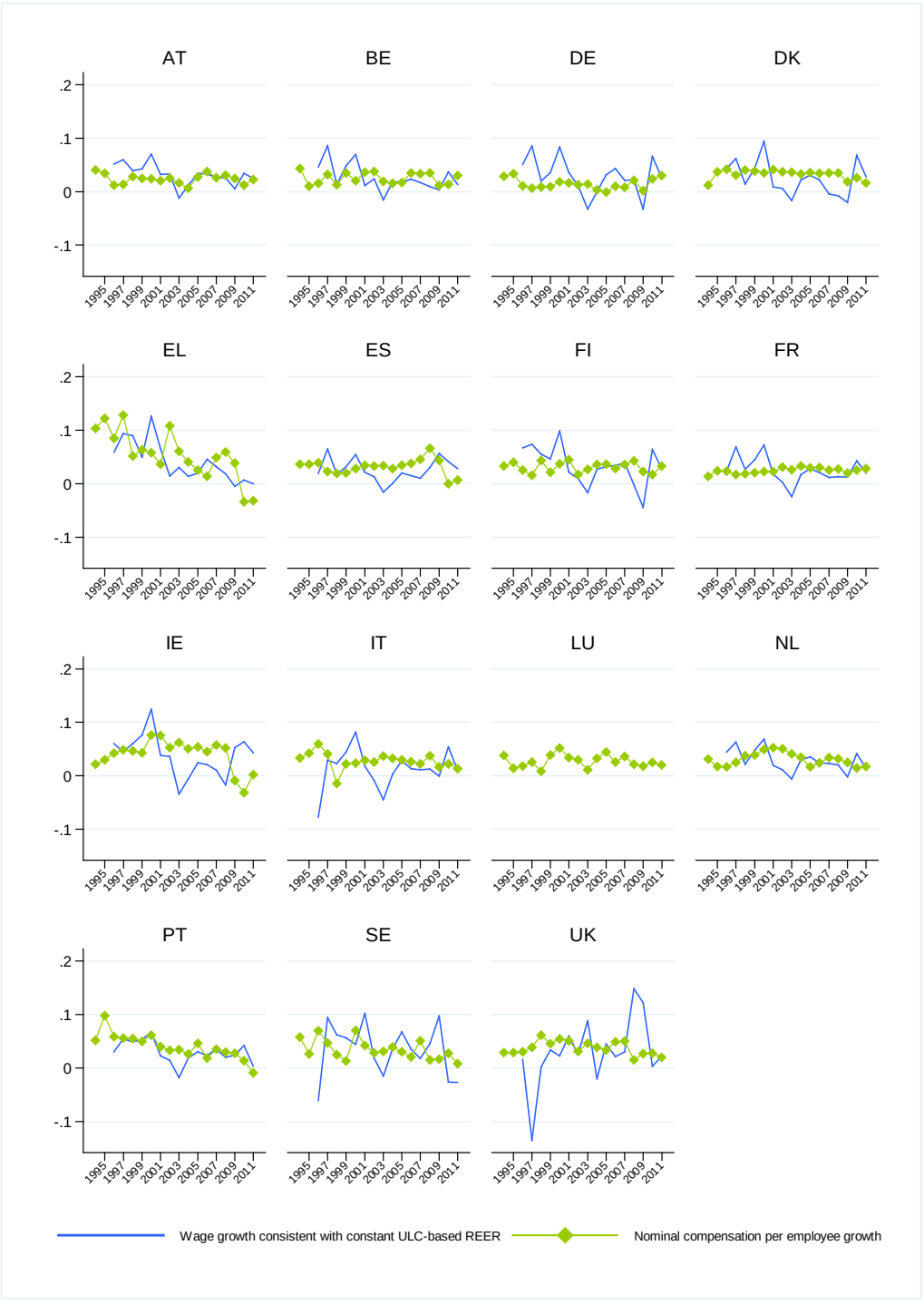

Graph 4: Difference between nominal compensation per employee and wage level benchmark in 2009, 2010 and 2011, (%, sorted by 2010 magnitudes)



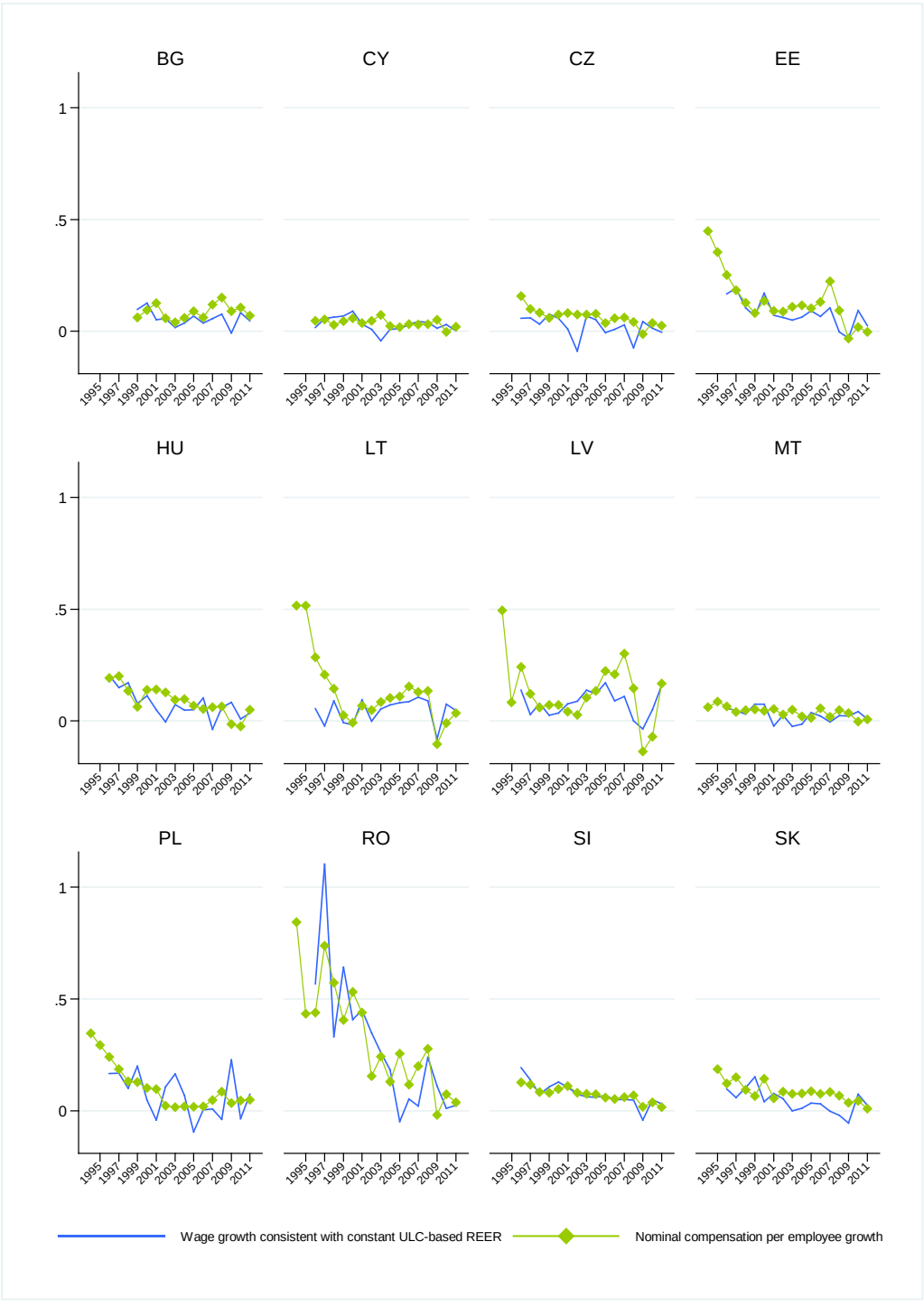
Graph 5: Difference between nominal compensation per employee and wage level benchmark in 2009, 2010 and 2011, (%, sorted by 2010 magnitudes)



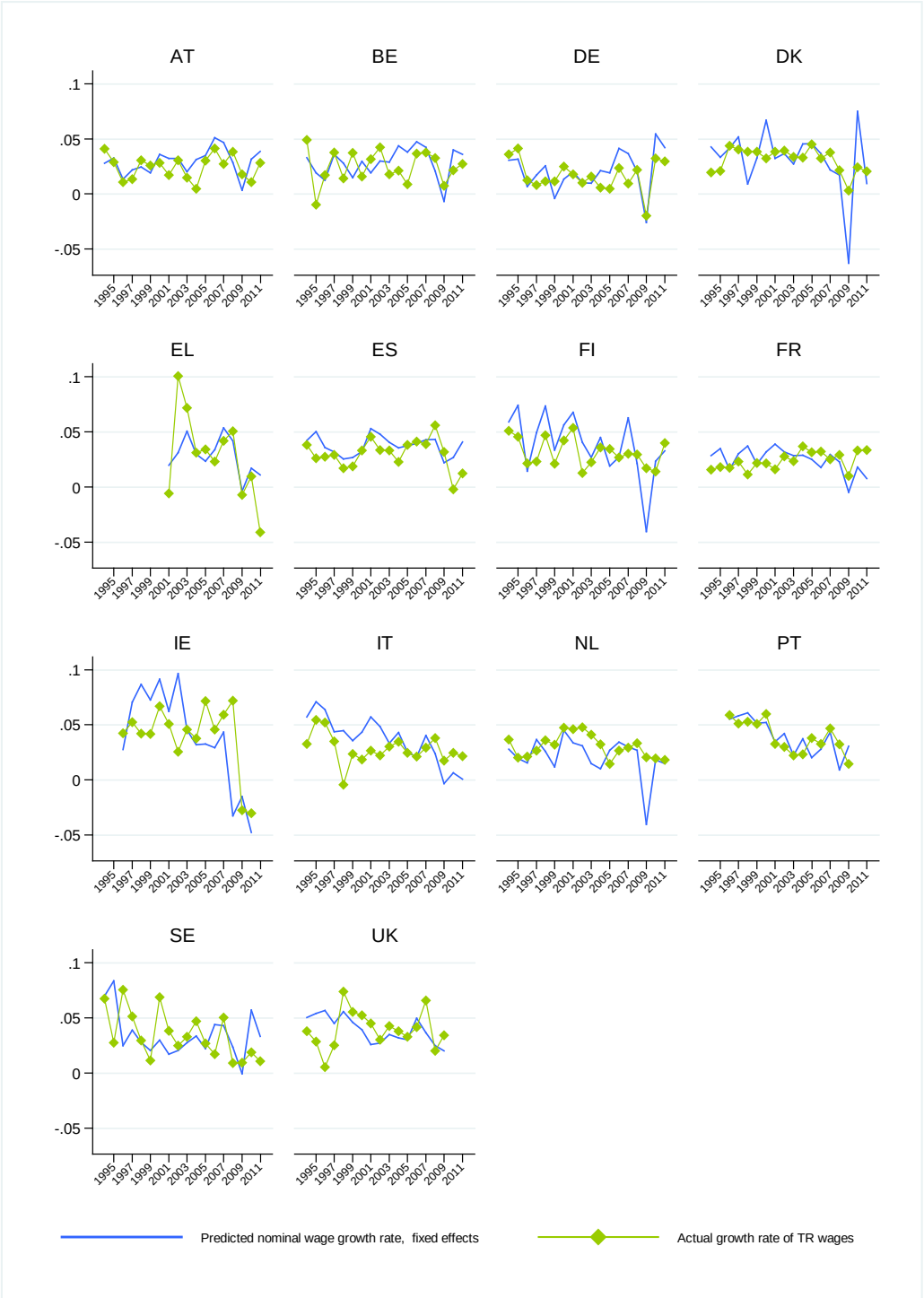
Graph 6: Benchmark for nominal compensation per employee growth: constant ULC-based REER, EU15 (EU member states before 2004)



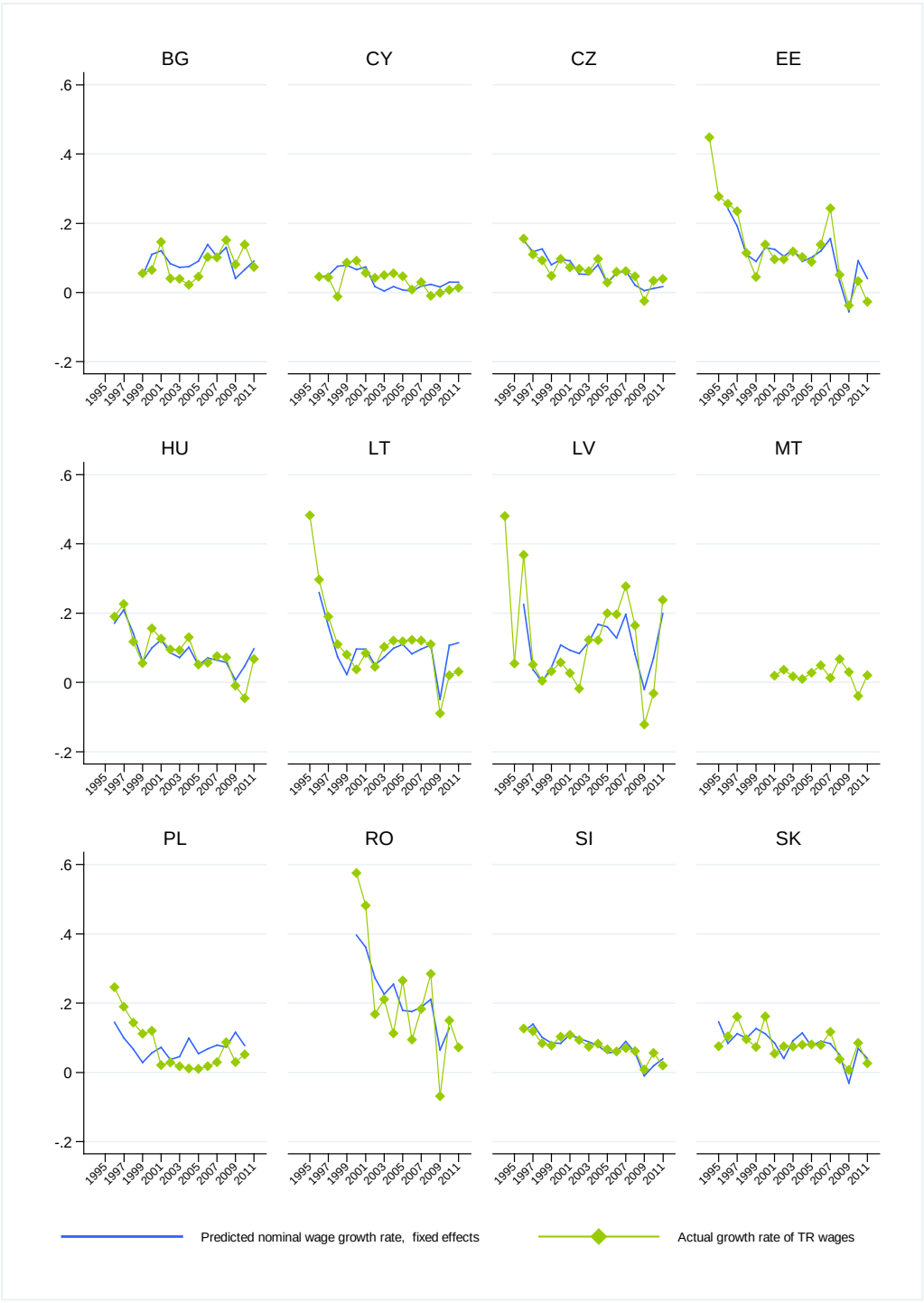
Graph 7: Benchmark for nominal compensation per employee growth: constant ULC-based REER, EU12 (EU member states since 2004)



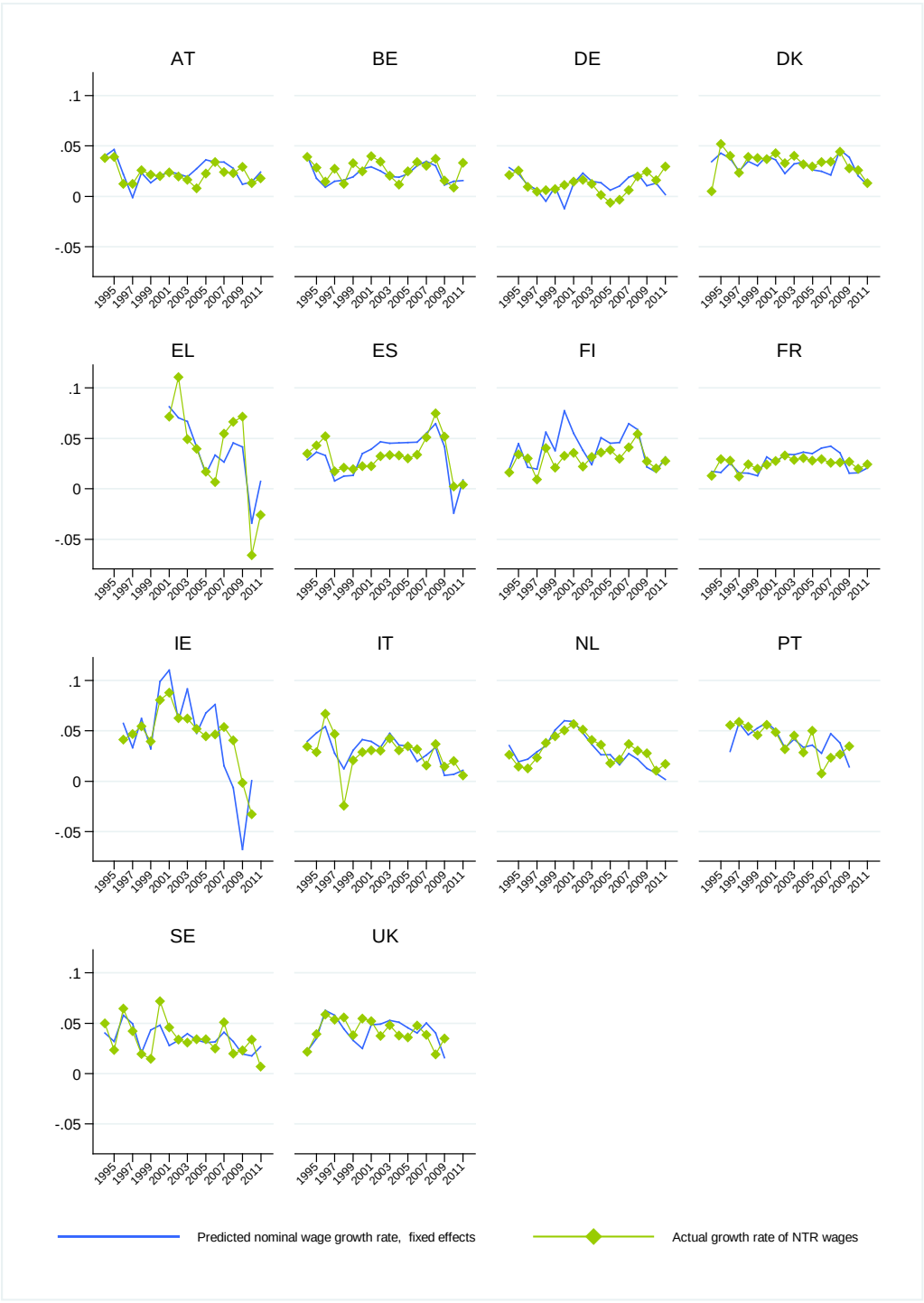
Graph 8: Benchmark for nominal compensation per employee growth in the tradable sector: prediction from wage equation, EU15 (EU member states before 2004)



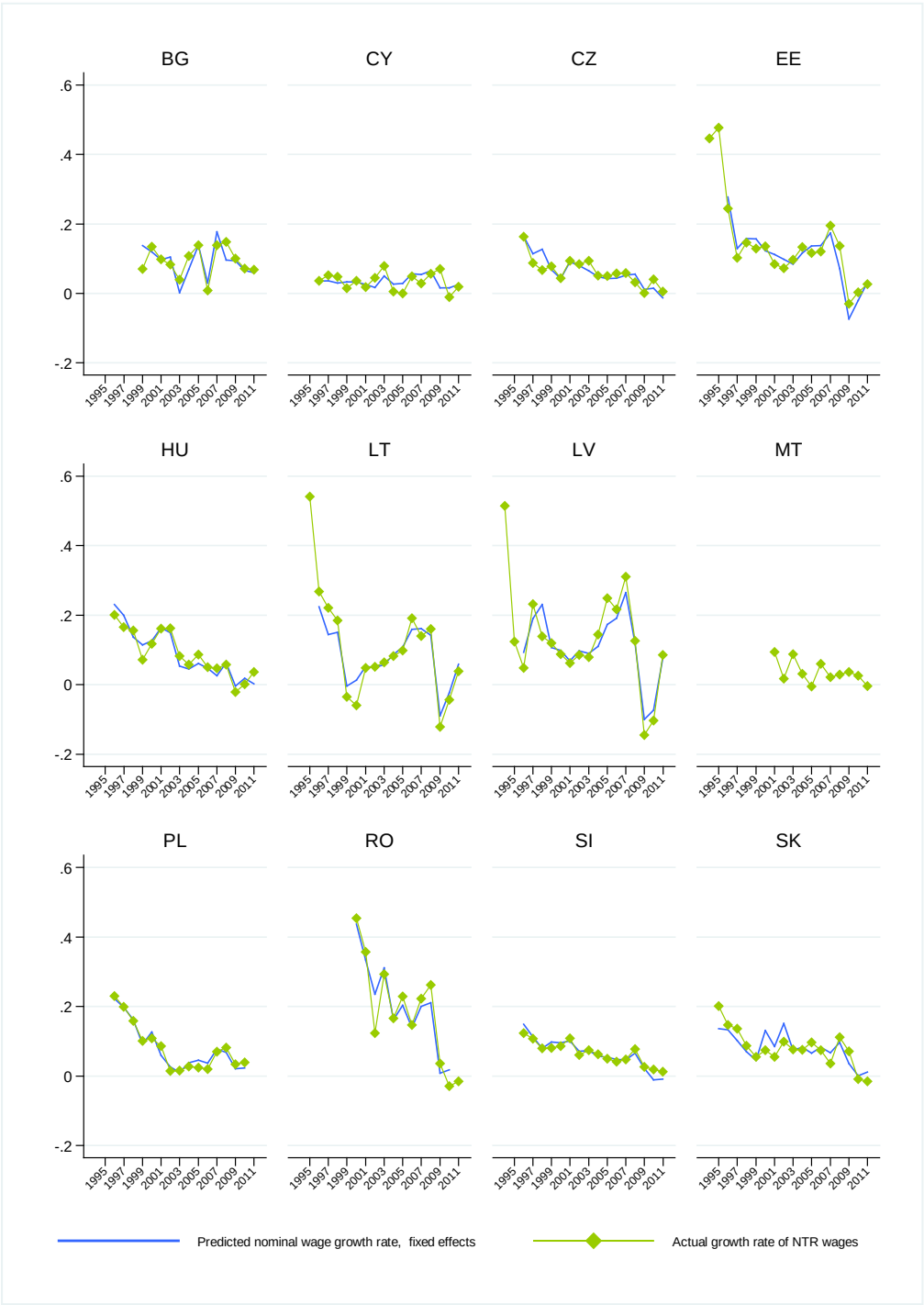
Graph 9: Benchmark for nominal compensation per employee growth in the tradable sector: prediction from wage equation, EU12 (EU member states since 2004)



Graph 10: Benchmark for nominal compensation per employee growth in the non-tradable sector: prediction from wage equation, EU15 (EU member states before 2004)



Graph 11: Benchmark for nominal compensation per employee growth in the non-tradable sector: prediction from wage equation, EU12 (EU member states since 2004)



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